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$\therefore\ \theta=67^\circ\ 43'$ nearly. $AB=2r\sec\theta=791.16$ feet.
$LK=2r(\sec\theta-1)=491.16$ feet.

Also solved by *J. SCHEFFER*.

CALCULUS.

119. Proposed by JOHN M. COLAW, A. M., Monterey, Va.

Rectify the Folium of Descartes, the equation of which is $x^3+y^3+3axy=0$.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

Substitute $-\frac{1}{\sqrt{2}}(x+y)$ and $-\frac{1}{\sqrt{2}}(x-y)$ for x and y, respectively, (revolving the axis through 135°) and the equation becomes

$$3y^2(a\sqrt{2}+2x)=x^2(3a\sqrt{2}-2x) \text{ or } 3y^2(a+x\sqrt{2})=x^2(3a-x\sqrt{2}).$$

$$\therefore\ y=\pm\frac{x\sqrt{(3a-x\sqrt{2})}}{\sqrt{[3(a+x\sqrt{2})]}}.$$

$$\frac{dy}{dx}=\frac{3a^2-2x^2}{\sqrt{[3(a+x\sqrt{2})^3(3a-x\sqrt{2})]}}.$$

$$\frac{ds}{dx}=\frac{\sqrt{[2(9a^4+12a^3x\sqrt{2}+12a^2x^2-4x^4)]}}{(a+x\sqrt{2})\sqrt{[3(a+x\sqrt{2})(3a-x\sqrt{2})]}}.$$

Let $a-x\sqrt{2}=2a\sin\theta$.

$$\therefore\ S=-\frac{a}{\sqrt{6}}\int\frac{\sqrt{(13-20\sin\theta+16\sin^3\theta-8\sin^4\theta)}}{1-\sin\theta}d\theta.$$

For the loop, $S=\dfrac{2a}{\sqrt{6}}\displaystyle\int_{-\frac{1}{2}\pi}^{\frac{1}{6}\pi}\frac{\sqrt{(13-20\sin\theta+16\sin^3\theta-8\sin^4\theta)}}{1-\sin\theta}d\theta.$

Also solved by *ELMER SCHUYLER*.

120. Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

The axis of a paraboloid of revolution coincides with the generating line of a cylinder; the diameter of a cylinder and the latus-rectum of the parabola are each equal to the common altitude, a. Find the surface and volume of each part into which the paraboloid is divided by the cylinder.

Solution by the PROPOSER.

$x^2+y^2=az$ is the equation to the paraboloid.
Volume of paraboloid$=v_1=\frac{1}{2}\pi a^3$.
Surface of paraboloid$=s_1=\frac{1}{6}\pi a^2(5\sqrt{5}-1)$.

$x^2+y^2=ax$ is the equation of the cylinder.

For the surface of the paraboloid within the cylinder,

$$\sqrt{[1+(dy/dx)^2+(dy/dz)^2]}=\frac{\sqrt{a}}{2}\sqrt{\frac{a+4z}{az-x^2}}.$$

$$\therefore\ s=\sqrt{a}\int_0^a\int_z^{\sqrt{az}}\sqrt{\frac{a+4z}{az-x^2}}dzdx$$

$$=\frac{\sqrt{a}}{2}\int_0^a[\pi-2\sin^{-1}\sqrt{(z/a)}]\sqrt{(a+4z)}dz=\frac{\sqrt{a}}{12}\int_0^a\frac{(a+4z)^{\frac{3}{2}}dz}{\sqrt{(az-z^2)}}-\frac{\pi}{12}a^2.$$

Let $z=a\sin^2\frac{1}{2}\theta$.

$$\therefore\ s=\frac{a^2}{12}\int_0^\pi[1+4\sin^2\tfrac{1}{2}\theta)]^{\frac{3}{2}}\,d\theta-\frac{\pi}{12}a^2.\quad\text{Let }\theta=\pi-2\varphi.$$

$$\therefore\ s=\frac{a^2}{6}\int_0^{\frac{1}{2}\pi}(5-4\sin^2\varphi)^{\frac{3}{2}}\,d\varphi-\frac{\pi}{12}a^2$$

$$=\frac{a^2}{18}[12E(2/\sqrt{5},\ \tfrac{1}{2}\pi)-F(2/\sqrt{5},\ \tfrac{1}{2}\pi)]-\frac{\pi}{12}a^2.$$

$\therefore$ s and s_1-s are the parts of the surface.

For the volume common to both.

$$v=2\int_0^a\left[\int_z^{\sqrt{az}}\sqrt{(az-x^2)}dx+\int_0^z\sqrt{(ax-x^2)}dx\right]dz$$

$$=\frac{1}{8}\int_0^a\left[\pi a^2+\pi az-4a\sqrt{(az-z^2)}-8az\sin^{-1}\sqrt{(z/a)}+2a^2\sin^{-1}\left(\frac{2z-a}{a}\right)\right]dz$$

$$=\tfrac{5}{32}\pi a^3.\quad v_1-v=\tfrac{11}{32}\pi a^3.$$

Also solved by *L. C. WALKER.*

MECHANICS.

123. Proposed by W. J. GREENSTREET, M. A., Editor of The Mathematical Gazette, Stroud, Gloucestershire, England.

Two equal uniform rods AB, BC are freely hinged at B; C rests on rough horizontal plane, and A is attached to point above it. When C is as far as possible from A for equilibrium, AB, BC make angles α, β, respectively, with the vertical. Find the coefficient of friction between the rod at C and the plane.